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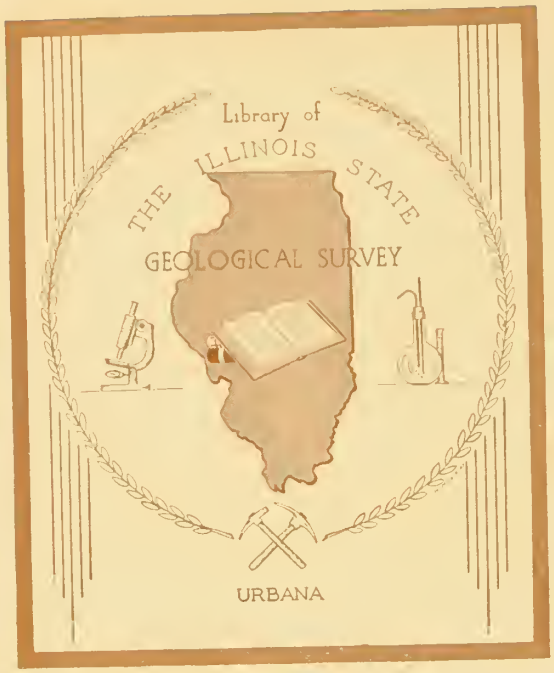
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AN APPLICATION OF GEOLOGIC INFORMATION TO LAND USE IN THE CHICAGO METROPOLITAN REGION*

James E. Hackett

Application of geologic information to planning the use of land in a metropolitan area was exemplified by a planning study concerned with acquisition of land for the DuPage County Forest Preserve. The geology of the area was studied to determine the potential multiple use of the land, taking into consideration four factors, (1) the presence of mineral resources, (2) the occurrence of ground water, (3) potential for surface water reservoirs, and (4) suitability for disposal of wastes.

The county was divided into several classes of geological environments, and the suitability of each for specific uses was designated. This information contributed to a land acquisition plan that would have several advantages, including prevention of urban encroachment on the river floodplain, preservation of mineral resources for future use, opportunity to institute water management programs, and provision for development of water-based recreational facilities.

INTRODUCTION

More than 6½ million people live within a six-county area of 3714 square miles in northeastern Illinois. Projections indicate that by 1980 the population will approach eight million. The expanding urbanization accompanying such an increase in population results in conflicting demands on the available land to provide necessary facilities. Space is needed to accomodate streets, roads, highways, expressways, rail lines, and airfields that serve the travel and commuting needs of this extremely mobile society. Space is required for industrial facilities, for recreational and aesthetic needs, and

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* From an address presented at the 1965 Annual Conference on Interaction of Urbanization and the Mineral Industries, sponsored by the Natural Resources Institute of the Ohio State University, Columbus, Ohio.

for the recovery of mineral resources, particularly those necessary for the construction of the roads, bridges, interchanges, and buildings that constitute the urbanized area. Space also is needed for disposal of the wastes produced by a complex society. Even flood and storm waters must be considered in terms of space, for these waters must be accommodated, whether it be on a river floodplain or on land already devoted to other uses.

The competition for space makes it necessary to consider the use of the land in terms of both efficiency and maximum benefit accrued. The alternatives are continued widespread contamination of the physical environment by waste products, lives lost and property damaged by floods, and loss of valuable mineral resources as they are covered up by houses, highways, and other constructions.

One approach to the problem of undirected urbanization that is gaining recognition is the multiple-use concept, under which the use of land for a single purpose when it could be used for several is considered inefficient. For example, the construction of residential properties on land that contains recoverable mineral resources, with the consequent loss of those resources, is inefficient use of that land. If the multiple-use potential of still-open areas were determined, such losses could be minimized.

Recently the Illinois State Geological Survey, recognizing that people coping with the problems of the human environment would need specialized geologic information, instituted a program of environmental geology in the metropolitan area of northeastern Illinois. One of the important functions of this program is providing the geologic information needed to determine whether the land in the path of urban growth can be used for more than one purpose. For instance, the Survey made a recent study* in DuPage County, at the request of the Northeastern Illinois Planning Commission, to obtain such data. The report included detailed descriptions of the geologic elements found in the county and maps showing their distribution. The geologic information presented here is abstracted from that report to show how geology, land-use planning, and conservation of resources are interrelated.

DU PAGE COUNTY STUDY

DuPage County is directly in the path of the westward spread of urbanization from the city of Chicago and expects by 1980 an increase of nearly 120 percent of the 1960 population of 313,500, the highest increase of all the metropolitan counties.

The Forest Preserve Commission of the county, concerned with developing a land acquisition program for extending existing forest areas, asked the Northeastern Illinois Planning Commission to study the problem.

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* Landon, R. A., Hackett, J. E., and Hughes, G. M., Geologic conditions relative to open-space considerations in DuPage County, Illinois: unpublished report to the Northeastern Illinois Planning Commission, 1965.

From the start it was understood that any plan proposed would emphasize the multiple-use potential of land designated for forest preserve use, and, therefore, knowledge of the physical environment would be required. The Geological Survey was requested by the Planning Commission to provide the geologic data for the plan.

Land-Use Factors

Four factors to be considered in determining potential uses for open space were designated by the Planning Commission: (1) presence of mineral resources; (2) occurrence of ground water; (3) potential for surface water reservoirs; and (4) suitability for disposal of wastes.

As the basis for evaluation of the mineral-resource potential of DuPage County, the Geological Survey reported the type of minerals present, the extent of the deposits, and the depth to buried deposits. The principal mineral resources of the area are sand and gravel, dolomite, and borrow material for fills.

Also considered were those aspects of ground-water resource management involving artificial recharge of near-surface aquifers by spreading water on the land surface or introducing it by means of pits and excavations. The area most likely to be suitable for the spreading basin and pit methods are those where the dolomite and sand and gravel aquifers are at land surface or are overlain by less than 30 feet of overburden.

For reservoirs, areas in which leakage would be at a minimum were considered most suitable. Multipurpose reservoirs that can be used for flood control, recreation, ground-water recharge, and low-flow augmentation have a high priority claim in open-space planning, but all these uses are not always completely compatible.

Maximum protection from pollution and contamination of water resources is thought to be afforded where thick deposits of relatively impermeable rock materials separate the waste disposal site from permeable materials that could allow the contaminants and pollutants to spread. Areas where such relatively impermeable materials were less than 30 feet thick, were arbitrarily considered as least protective. Sanitary landfill, waste lagoon, and septic system methods were given consideration. Septic systems present a special problem in highly urbanized areas in that the conditions under which they function best are those in which the potential for contamination is greatest.

Geologic Environments

The most common earth material in the county is a silty clay till. Associated with the till in two of the three small drainage streams of the county is sand and gravel outwash. In the northwestern corner of the county is a sand and gravel deposit that is part of an extensive outwash plain, most of which lies beyond the county line. Other sand and gravel deposits form

isolated ridges and mounds, the larger of which occur in the northern part of the county. In the western and southwestern parts of the county, thin, discontinuous deposits of sand and silt overlie the silty clay till. Other minor surficial deposits consist of peat and muck in small depressions and local occurrences of silt and clay believed to have been deposited in lake beds. In addition, dolomite bedrock of Silurian age is present at the land surface in a few small areas in the southern and eastern parts of the county. Commonly present over these materials is a deposit of wind-blown silt (loess) that in places is as much as 8 feet thick.

Subsurface information obtained from many water well records and over 3000 engineering borings was used to determine the thickness of the silty clay till immediately beneath the land surface and the thickness and extent of sand and gravel deposits within the glacial drift.

Several general classes of geologic environments were established to fit the various land uses designated by the Planning Commission, and the county was divided according to these classes, as shown in table 1.

TABLE 1 - GEOLOGIC ENVIRONMENTS OF DU PAGE COUNTY

Environment	Description of underlying material
C-1	Sand and gravel outwash with less than 5 feet of cover material, commonly floodplain silts and clays
C-2	Sand and gravel deposits concentrated in ridges and mounds; extremely varied in character and cover conditions
F-1	Silty clay till 30 feet thick underlain by sand and gravel deposits more than 10 feet thick, or by dolomite bedrock
F-2	Silty clay till 30 to 75 feet thick underlain by sand and gravel or dolomite bedrock
F-2a	Small local deposits of sand and gravel common
F-2b	Local deposits of sand and gravel rare
F-3	Silty clay till more than 75 feet thick over sand and gravel or dolomite
F-4	Surficial lacustrine silts and clays, 30 feet thick locally
M	Thin discontinuous sand and silt underlain by silty clay till at depths of less than 10 feet

The relations between the geologic environments and the land-use designations set up by the Planning Commission are shown in table 2. For each environment, its degree of suitability for a specific use is designated.

"A" indicates the environment is satisfactory in most respects for a particular use. "B" signifies a slightly less satisfactory environment, "C" a not wholly unsatisfactory environment, and "D" a generally unsatisfactory one.

TABLE 2 - RELATIONS OF LAND USE TO GEOLOGIC ENVIRONMENTS

Use	Rating	Environments	Remarks
Recovery of mineral resources	A	Exposed bedrock, C-1, C-2	
	A-D	F-1	Rating dependent on thickness of cover
	D	F-2, F-3, F-4	
Impoundment reservoir development	A	F-2, F-3, F-4	
	B	F-1	
	D	Exposed bedrock, C-1, C-2	Can be used if extreme care is taken to avoid leakage
Management of ground-water resources (artificial recharge by pits or spreading basins)	A	Exposed bedrock, C-1	In abandoned quarries
	B	C-2, F-1	Can be used where aquifer can be reached by excavation
	D	F-2, F-3, F-4	
Waste disposal (sanitary landfills, waste lagoons, septic systems)	A	F-2, F-3, F-4	Based on arbitrary requirement for presence of 30 feet of relatively impermeable materials between point of disposal and permeable materials
	B	M	
	D	F-1, C-1, C-2	

CONCLUSIONS

The study conducted by the Planning Commission recognized that recovery of mineral resources and management of water resources are particularly important in open-space planning in DuPage County. Both lend themselves well to a multiple-use approach because of the geology of the county. Excavation of the sand and gravel resources would provide the opportunity to refashion the landscape and develop recreational lakes in the pits left by the removal of the minerals. These holes also can be used as ready-made recharge pits to supplement ground-water storage in areas where excessive use of water has created the need for additional supplies. They also could be used as storage areas for floodwater that could augment the low flow of the rivers for necessary waste dilution.

The two drainage valleys that cross the county have the best mineral potential, and acquiring that land for forest preserves would (1) prevent urban encroachment in the river floodplain, which has long been the aim of planners in the area; (2) keep accessible the mineral resources to help fill the construction needs of the urbanizing area; (3) allow the institution of water management programs, by combining artificial recharge operations and reservoir development, that will alleviate flood problems and stabilize stream flow so that wastes can be diluted; and (4) provide water-based recreational facilities not now available by the development of multiple-use reservoirs and by making lakes in areas excavated for mineral resources.

The study in DuPage County helps to illustrate the means by which wise use of land and resources can be achieved in an urban area. True conservation requires a recognition of the close relations that exist between resource development and community needs such as open space, recreational facilities, and water-resource management programs. How well these needs can be integrated depends to a great extent on the existing physical conditions of the land. A basic knowledge of these conditions can help to determine proper use of the land so that the whole community will benefit.

ENVIRONMENTAL GEOLOGY NOTES SERIES

1. Controlled Drilling Program in Northeastern Illinois: J. E. Hackett and G. M. Hughes. April 1965.

2. Data from Controlled Drilling Program in DuPage County, Illinois: Jean I. Larsen and C. R. Lund. May 1965.

3. Activities in Environmental Geology in Northeastern Illinois: Jean I. Larsen and J. E. Hackett. June 1965.

4. Geological and Geophysical Investigations for a Ground-Water Supply at Macomb, Illinois: Keros Cartwright and D. A. Stephenson. July 1965.

5. Problems in Providing Minerals for an Expanding Population: H. E. Risser. July 1965.

6. Data from Controlled Drilling Program in Kane, Kendall, and DeKalb Counties, Illinois: C. R. Lund. October 1965.

7. Data from Controlled Drilling Program in McHenry County, Illinois: C. R. Lund. November 1965.